CLAIMS

1. An optical sensor assembly comprising:
a plurality of optical fibre sensor coils optically coupled by optical fibre; and
an elongate support element, on which said plurality of optical fibre sensor coils and optically coupling optical fibre are mounted; wherein
said support element has an elastic limit such that when said support element is bent away from the elongate axis, the optical fibre fracture limit is reached before the elastic limit is reached.

2. An optical sensor assembly according to claim 1, said support element has an elastic limit such that when said support element is bent away from the elongate axis around a curve having a radius of half a metre the support element elastic limit is not reached.

3. An optical sensor assembly according to any one of the preceding claims, wherein said support element is a flexible rod.

4. An optical sensor assembly according to claim 3, wherein said rod has a circular cross section.

5. An optical sensor assembly according to claim 3 or 4, wherein said support element comprises a carbon fibre rod.

6. An optical sensor assembly according to claim 3 or 4, wherein said support element comprises a steel rod.

7. An optical sensor assembly according to any one of the preceding claims, wherein said plurality of optical fibre sensor coils are arranged optically in series with each other.

8. An optical sensor assembly according to any one of the preceding claims, wherein said plurality of optical fibre sensor coils are mounted on said support element such that the distance between adjacent coils is substantially identical.

9. An optical sensor assembly according to any one of the preceding claims, said assembly further comprising a plurality of hollow mandrels corresponding to said plurality of optical fibre sensor coils, each of said mandrels having an internal and an external surface; wherein

each of said plurality of optical fibre sensor coils is wound around said external surface of said corresponding mandrel, said plurality of optical fibre sensor coils being mounted on said support element by connecting a portion of said internal surface of said corresponding mandrel to said support element.

10. An optical sensor assembly according to claim 9, wherein said portion of said internal surface connected to said support element comprises a central portion of said internal surface substantially mid way between either end of said mandrel.

11. An optical sensor assembly according to any one of claim 9 or 10, wherein said mandrel is substantially cylindrical in shape.

12. An optical sensor assembly according to any one of claims 9 to 11, wherein said mandrel comprises an inner member and an outer former; wherein

said outer former is mounted via at least one compressible seal on said inner member such that there is a cavity between said outer former and said inner member, said compressible seal being significantly more compressible than said outer former or said inner member such that it is operable to seal said cavity across a range of temperatures and pressures.

13. An optical sensor assembly according to any one of the preceding claims; at least one portion of said support element comprising an external surface that is compressible.

14. An optical sensor assembly according to claim 13, said compressible external surface of said support element comprising a compressible material mounted to cover said at least one portion of said support element.

15. An optical sensor assembly according to any one of claims 13 and 14, wherein said at least one portion of said support element comprising a compressible external surface includes said portions of said support element between said plurality of optical fibre sensor coils.

16. An optical sensor assembly according to claim 15, wherein said optically coupling optical fibres are wound around said compressible external surface of said support element.

17. An optical sensor assembly according to claim 16, said assembly further comprising further compressible material covering said optically coupling optical fibre and said compressible external surface.

18. An optical sensor assembly according to any of the preceding claims, further comprising a sheath of compressible material covering an outer envelope of said optical sensor assembly.

19. An optical sensor assembly according to any one of claims 14 to 18, wherein said compressible material comprises open celled foam.

20. An optical sensor assembly according to any one of the preceding claims, said assembly further comprising a protective cover mounted to substantially surround an outer surface of each of said plurality of optical fibre sensing coils.

21. An optical sensor assembly according to claim 20, said protective cover being mounted by attachment to said support element.

22. An optical sensor assembly according to any one of the preceding claims, said optical sensor assembly comprising four optical fibre sensor coils.

23. An optical sensor assembly according to any one of the preceding claims, wherein said plurality of optical sensing coils comprise a single hydrophone.

24. An optical sensing array comprising a plurality of optical sensor assemblies as claimed in any one of the preceding claims, said plurality of optical sensor assemblies being in optical communication with each other.

25. An optical sensing array according to claim 24, wherein said plurality of optical sensor assemblies are mechanically attached to one another by cords.

26. An optical sensing array according to claim 24 or 25, when dependent on claim18, wherein said sheath of compressible material covers said optical sensing array.

27. An optical sensing array according to any one of claims 24 to 26, said array further comprising a protective cover, said array having a substantially cylindrical outer envelope and said protective cover being in the form of a hose.

28. An optical sensing array according to claim 27 said array further comprising a buoyant fluid confined within said hose.

29. An optical sensing array according to claim 28, wherein said buoyant fluid is kerosene.

30. A mandrel for supporting an optical sensing coil, said mandrel comprising:
an inner member; an outer former; and
at least one compressible seal; wherein
said outer former is mounted via said at least one compressible seal on said inner member such that there is a cavity between said outer former and said inner member,

said compressible seal being significantly more compressible than said outer former or said inner member such that it is operable to seal said cavity across a range of temperatures and pressures.

31 A mandrel according to claim 30, said mandrel comprising a further compressible seal, said cavity being formed between said two compressible seals, said former and said inner member.

32. A mandrel according to claim 31, wherein said two compressible seals comprise O-rings.

33. A mandrel according to claim 32, wherein said O-rings have an external diameter of between 5 and 30 mm.

34. A mandrel according to any one of claims 30 to 33, wherein said at least one compressible seal has a thickness of between 1 and 5mm.

35. A mandrel according to any one of claims 30 to 34, wherein said at least one compressible seal is formed from rubber.

36. A mandrel according to any one of claims 31 to 35, wherein said inner member comprises two recesses, said two compressible seals being mounted within said two recesses.

37. A mandrel according to claim 36, said inner member comprising a further recess, said further recess forming a portion of said cavity.

38. A mandrel according to any one of claims 30 to 37, wherein said inner member is made of a substantially rigid material.

39. A mandrel according to claim 38, wherein said inner member is made of metal.

40. A mandrel according to any one of claims 30 to 39, wherein said former is made of plastic.

41. A method of constructing an optical sensor assembly, comprising a first step of winding from a single piece of optical fibre, a plurality of optical fibre sensor coils with optically coupling optical fibre therebetween onto a support element;
said support element having an elastic limit such that when said support element is bent away from the elongate axis, the optical fibre fracture limit is reached before the elastic limit is reached

42. A method of constructing an optical sensor assembly according to claim 41, wherein said plurality of optical fibre sensor coils are mounted on said support element such that the distance between adjacent coils is substantially identical.

43. A method of constructing an optical sensor assembly according to claim 41 or 42, comprising mounting a plurality of hollow mandrels corresponding to said plurality of optical fibre sensor coils on said support element, said optical fibre sensor coils being wound onto said mandrels mounted on said support element.

44. A method of constructing an optical sensor assembly according to claim 43, said mandrels being mounted on said support element by connecting a central portion of said internal surface substantially mid way between either end of said mandrel to said support element.

45. A method of constructing an optical sensor assembly according to any one of claims 41 to 44, further comprising the step of covering at least one portion of said support element with a compressible material.

46. A method of constructing an optical sensor assembly according to claim 45, wherein said compressible material comprises open celled foam.

47. A method of constructing an optical sensor assembly according to claim 45 or 46, wherein said at least one portion of said support element includes said portions of said support element between said plurality of optical fibre sensor coils, said portion of said optical fibre optically coupling said optical fibre sensor coils being wound onto said compressible material under tension such that said compressible material is not totally compressed.

48. A method of constructing an optical sensor assembly according to claim 47, further comprising the step of covering said optically coupling optical fibre and said compressible material mounted on said support element with further compressible material.

49. A method of constructing an optical assembly according to any one of claims 41 to 48, said optical assembly comprising an optical assembly according to any one of claims 1 to 23.

50. A method of constructing an optical sensing array comprising constructing a plurality of optical sensor assemblies according to any one of claims 41 to 49, and further comprising the steps of:
linking said optical sensor assemblies together to form said sensor array;
said linking being done mechanically by cord, and optically by optical fibres, said linking optical fibres being longer than said cord.

51 A method of constructing an optical sensing array according to claim 50, comprising a further step of covering said plurality of optical sensor assemblies with a sheath of compressible material.

52. A method of constructing an optical sensing array according to claim 51, comprising a further step of covering said array with a protective cover, said array having a substantially cylindrical outer envelope and said protective cover being in the form of a hose.

53. A method of constructing an optical sensing array, according to claim 52, said method comprising the further step of introducing a buoyant fluid into said hose.

54. A method of constructing an optical sensing array according to claim 53, wherein said buoyant fluid is kerosene.

55. An optical sensor assembly substantially as herein described with reference to Figures 5 to 10.

56. An optical sensing array substantially as herein described with reference to Figures 5 to 10.

57. A mandrel substantially as herein described with reference to Figures 6 and 8.

58. A method of constructing an optical sensor assembly substantially as herein described with reference to Figures 5 to 10.

59. A method of constructing an optical sensing array substantially as herein described with reference to Figures 5 to 10.